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WARZYN
ENGINEERING INC

Consulting Engineers • Civil • Structural • Geotechnical • Materials Testing • Soil Borings • Surveying

1409 EMIL STREET, P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

January 6, 1981
C 9560

Mason & Hanger - Silas Mason Company, Inc.
1500 West Main Street
Lexington, KY 40505

Attention: Dr. Harry J. Sterling

Re: Waukegan Harbor Slip No. 3 Investigation
Waukegan, Illinois

Gentlemen:

We have completed the soil sampling and testing in Waukegan Harbor Slip No. 3 and hereby submit six (6) copies of the subject report for your use. The investigation was performed in accordance with our subcontract agreement for the above referenced project.

We hope that the report is suitable for your needs. If you have any questions, please do not hesitate to contact us.

Very truly yours,

WARZYN ENGINEERING INC.

Daniel R. Viste

Daniel R. Viste, CPGS
Project Manager

DRV/dkp
[WEI-13-19]

Encl: as stated

INTRODUCTION

This report describes soil sampling and testing work performed during November 19 through November 22, 1980 at Waukegan Harbor Slip No. 3. The purpose of the sampling program was to obtain soil samples for PCB analysis and to test particular engineering properties of the sediment. Waukegan Harbor is located in Section 22, T45N, R12E, Lake County, Illinois. Slip No. 3 is located at the north end of the harbor (see Drawing C 9560-B1). Chain of custody methods were employed and care was taken to attempt collection of chemically undisturbed samples as indicated by Mason and Hanger - Silas Mason Company, Inc. These methods are described later in the text.

CHAIN OF CUSTODY PROCEDURES

Chain of custody procedures were employed with regard to handling of samples obtained in this investigation. The following discussion describes chain of custody procedures employed.

On November 19, 1980, three Shelby tube samples (ASTM D 1587) were obtained which required chain of custody procedures. One sample from Boring 5 and two samples from Boring 4 were affixed with Environmental Protection Agency (EPA) approved chain of custody seals and stored under observation or locked securely. At the end of the day, the samples were signed over from the Field Sampler, James A. Hill, to the Field Custodian, Geoffrey F. Prior, both of Warzyn Engineering; dated November 19, 1980.

On November 20, 1980, one additional Shelby tube sample from Boring 4 was obtained. The sample was affixed with a chain of custody seal and stored under observation or locked securely. Additionally, eight split-spoon samples (ASTM D 1586) from Boring 4 were stored in jars and kept under observation or locked securely until they could be affixed with chain of custody seals on the following day.

On November 21, 1980, Borings 2 and 3 were completed. Fifteen split-spoon samples were collected and placed in jars which required chain of custody procedures. These jar samples were placed in a box along with the eight jar samples from Boring 4. The box was affixed with chain of custody seals and stored under observation or locked securely. At the end of the day, Geoffrey F. Prior, of Warzyn Engineering, retained custody of the samples.

On November 22, 1980, Borings 1 and 6A were completed. Sixteen split-spoon samples were collected and placed in jars which required chain of custody procedures. These jar samples were placed in a box to which was affixed chain of custody seals and stored under observation or locked securely. At the end of the day, Geoffrey F. Prior, of Warzyn Engineering, retained custody of the samples.

On November 24, 1980, all Shelby tube samples were subportioned and placed in jars for physical testing by Warzyn Engineering and chemical testing by Raltech Scientific Services of Wisconsin. Each jar sample was affixed with chain of custody seals and stored under observation or locked securely. Also, on this date, split-spoon sample boxes from Borings 1, 2, 3, 4 and 6A were opened, and the jar samples sorted for laboratory testing. Warzyn Engineering retained custody of the following Samples; B1S1A, B2S1A, B2S2B, B3S1A, B3S2A, B4S1A, B4S5A, B5S1B, B6AS1A, B6AS3A. The remaining jar samples were affixed with chain of custody seals and stored under observation or locked securely until they were signed over to Vincent Deneen, of Raltech Scientific Services of Madison for chemical analysis per Mason and Hanger's request.

SAMPLE COLLECTION, FIELD PROCEDURES, AND SAMPLE PREPARATION

Prior to mobilization to Waukegan Harbor, the drill rig (CME 55) and related equipment were steamed cleaned to remove oil, grease and mud. Harbor operations were accomplished by positioning the drill rig on two joined section barges (dimensions approximately 20 feet by 50 feet each) which were initially powered to Slip No. 3 by a tugboat and later manually moved to boring locations. Drilling operations were performed off the end of the barge.

Present during sampling operations were Warzyn Engineering drillers and a field geologist, and Harry J. Sterling, Jr. of Mason and Hanger. Also, Jeffrey L. Bruestle, of ENCOTEC, observed from the near shore.

The following general procedures were employed at each boring location. The barge was maneuvered into position manually and secured with ropes. Water depth was measured by means of a weighted fiberglass tape. This measurement was referenced to the top of an iron plate (B.M.), covering an outfall near Boring 1. Boring locations were measured with a fiberglass tape from the northwest end of Slip No. 3 and from the sheet piling retaining walls (refer to Drawing C 9560-B1).

Drilling tools and related apparatus were cleaned with acetone and placed on clean plastic sheets. A 4 inch diameter casing was then lowered into the water and allowed to settle under its own weight into the muck. From past experience, a measurement of the amount of settlement of the casing equals the thickness of muck. Classification of the muck was determined from previous on-site testing performed by Warzyn Engineering in July 1980. The muck inside the casing was then flushed with harbor water using conventional rotary drilling procedures. The washwater and drill cuttings were retained in the washtub for later disposal.

A sediment sample was then obtained by either hydraulically pushing a 3 inch diameter, acetone rinsed, Shelby tube/piston sampler apparatus for 24 inches or refusal (ASTM D 1587), or driving a 2 inch diameter, acetone rinsed, split-barrel sampler for 24 inches or refusal using a 140 pound weight falling freely through a distance of 30 inches (ASTM D 1586). Where Shelby tubes were taken, the tube ends were covered with aluminum foil and plastic caps, affixed with chain of custody labels, then frozen upright in dry ice. After delivery to Warzyn Engineering, the frozen Shelby tube samples were: 1) cut into 6-inch sections, 2) placed in acetone rinsed jars, 3) capped with aluminum foil and screw-on lids, and 4) affixed with EPA chain of custody labels. Where split-barrel samples were taken, the sampler was opened onto clean plastic sheeting (polyethylene) and visually examined. The recovered sample was then: 1) cut into 6-inch sections, 2) placed in acetone-rinsed jars, 3) capped with aluminum foil and screw-on lids 4) assigned a boring number, sample number and letter designation (letter designations were assigned alphabetically, starting with the bottom of the sample, example: S1A, bottom 6 inches of the sample; S1B, 6 inches to 12 inches above the bottom of the sample; S1C, 12 inches to 18 inches above the bottom of the sample, etc.), depth of sample, blow counts, and date and 5) placed in a box to which was affixed with chain of custody labels.

The borings were advanced by turning the casing downward to the bottom of the previous sample and then cleaning out the casing using recirculated harbor water and conventional rotary drilling procedures. Sampling intervals continued from below the bottom of the muck through 12 inches into the underlying clay.

At the end of each bore hole sampling, a thick bentonite mud was pumped to the base of the casing to plug the hole. The casing was then pulled. The washtub water was then decanted into the harbor and the remaining drill cuttings were shoveled into 55 gallon drums for disposal as hazardous waste. The tools, washtub, deck of the barge, and rear of the drill rig were hosed down with harbor water between bore holes to remove sediment and to flush the pumps and hoses. The tools, casing, drill rod, and washtub were rinsed with acetone and placed on a clean plastic sheet in preparation for the next boring. Logs of borings were kept throughout the sampling operation. Refer to Appendix C for boring logs.

A summary of soil samples obtained and parties accepting final responsibility is as follows:

Boring Location	Samples Obtained	Person/Company Assuming Custody
B #1	S1C	Vincent Deneen/Raltech
	S1B	"
	S1A	Geoffrey F. Prior/Warzyn Engineerin
	S2C	Vincent Deneen/Raltech
	S2B	"
	S2A	"
B #2	S1C	Vincent Deneen/Raltech
	S1B	"
	S1A	Geoffrey F. Prior/Warzyn Engineerin
	S2B	"
	S2A	Vincent Deneen/Raltech
	S3C	"
	S3B	"
	S3A	"
B #3	S1B	"
	S1A	Geoffrey F. Prior/Warzyn Engineerin
	S2B	Vincent Deneen/Raltech
	S2A	Geoffrey F. Prior/Warzyn Engineerin
	S3C	Vincent Deneen/Raltech
	S3B	"
	S3A	"

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Boring Location	Samples Obtained	Assuming Custody
B #4	S1C	"
	S1B	"
	S1A	Geoffrey F. Prior/Warzyn Engineering
	S2C	Vincent Deneen/Raltech
	S2B	"
	S2A	"
	S3C	"
	S3B	"
	S3A	"
	S4C	"
	S4B	"
	S4A	"
	S5B	"
	S5A	Geoffrey F. Prior/Warzyn Engineering
	S6C	Vincent Deneen/Raltech
	S6B	"
	S6A	"
B #5	S1D	"
	S1C	"
	S1B	Geoffrey F. Prior/Warzyn Engineering
	S1A	Vincent Deneen/Raltech
B #6A	S1B	"
	S1A	Geoffrey F. Prior/Warzyn Engineering
	S2B	Vincent Deneen/Raltech
	S2A	"
	S3C	"
	S3B	"
	S3A	Geoffrey F. Prior/Warzyn Engineering
	S4C	Vincent Deneen/Raltech
	S4B	"
	S4A	"

ENGINEERING TEST RESULTS

Six borings were performed penetrating 6.5 feet to 9.8 feet of water and 2.5 feet to 14.0 feet of harbor sediments. Boring locations are shown on Drawing C 9450-B1. Soil samples retained by Warzyn Engineering were analyzed for natural moisture content, grain size, and density. However, samples of non-cohesive soils do not yield accurate density test results due to disturbance by the sampling method; therefore, these results should be considered as a minimum density. The above test data are contained in Appendix D.

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General sediment stratigraphy, in descending order, is as follows:

Soil Description Unified Soil Classification System (USCS)	Typical Grain Size Distribution (%Gravel/Sand/Silt & Clay)
Very Loose, Black, Organic Clayey Silt, Trace to Some Fine Sand; MUCK (OL)	1/38/61
Loose to Medium Dense Gray Fine Sand, Trace to Some Silt, (SP-SM) (Occasional Lenses of Medium Dense Fine to Coarse Sand, Some Fine Gravel, Little Silt) (SW-SM)	0/92/8
Stiff to Very Stiff, Gray Clay and Silty Clay, Little Fine to Medium Sand, Trace Fine to Medium Gravel	2/17/81

The scope of the project did not include sampling and testing of the upper muck unit. This unit was sampled and tested during previous on-site testing performed by Warzyn Engineering in July, 1980. The thickness of the muck was recorded, however, and ranged from 0.5 feet to 4.4 feet, generally thinning southeastward of Boring 1.

Additionally, in-situ field penetration tests were performed at four locations. This data is contained in Appendix E. The general procedure is outlined as follows: 1) a steel plate was lowered to the bottom and the distance between the top of the plate and a fixed reference point was recorded, 2) weights were then added incrementally and the apparatus was allowed to settle until additional settlement was not observed (typically 3-4 minutes), 3) the distance between the top of the apparatus and the fixed reference point was recorded for each successive loading increment, and 4) buoyancy forces were calculated from the specific gravity and volume

of the apparatus, and were subtracted from the gross loading. The data indicates a relatively high penetration depth near Boring 2 and substantially lower penetration depth near Borings 3, 4 and 5. (See Drawing C 9560-B1 for test locations.)

Beneath the muck unit is predominately a gray, fine to medium sand (SP-SM), little to trace silt and clay. A few thin lenses of fine to medium gravel were observed. This unit varied in thickness from 2.5 feet at Boring Location 1 to 8.0 feet at Boring Location 4, with no general thickness trend apparent. Natural moistures varied from 10% to 24%.

Underlying the sand unit is a stiff to very stiff, gray, silty clay, little fine to coarse sand, little fine to medium gravel. Typically, the borings penetrated only 12 inches into this layer. Warzyn Engineering performed no laboratory tests on samples from this unit.

CLOSING REMARKS

We trust this report, and the information contained herein, meets your present needs. If you have any questions or desire further information, please feel free to contact us.

Respectfully submitted,

WARZYN ENGINEERING INC.

Geoffrey F. Prior

Geoffrey F. Prior
Geologist

Daniel R. Viste

Daniel R. Viste, CPGS
Project Manager

GFP/DRV/dkp
[WEI-9-18]

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APPENDIX "A"

Subsurface Investigation

GENERAL REMARKS

We have endeavored to evaluate subsurface conditions and physical properties of the subsoil as revealed by the borings and laboratory testing. A problem inherent in this evaluation is the variability in engineering properties within soil strata involved, and specifically in any location variation in the soil which is located between borings. Due to natural or man-made causes, subsurface conditions may change with time.

Conclusions drawn and recommendations given in this report are for a specific proposed use of this site. They are our opinions and are based upon conditions that existed at the boring locations and such parameters as proposed site usage, soil loading, elevations, etc..

Since subsurface conditions depend on seasonal moisture variations, frost action, construction methods, and the inherent natural variations, careful observations must be made during construction. These should be brought to our attention as it may be necessary to modify the conclusions and recommendations presented herein.

FIELD METHODS
for
EXPLORATION AND SAMPLING SOILS

A. Boring Procedures Between Samples

The bore hole is extended downward, between samples, by a continuous flight auger, driven and washed-out casing, or rotary boring with drilling mud or water.

B. Standard Penetration Test and Split-Barrel Sampling of Soils (ASTM* Designation: D 1586)

This method consists of driving a 2" outside diameter split barrel sampler using a 140 pound weight falling freely through a distance of 30 inches. The sampler is first seated 6" into the material to be sampled and then driven 12". The number of blows required to drive the sampler the final 12" is recorded on the log of borings and known as the Standard Penetration Resistance. Recovered samples are first classified as to texture by the driller. Later, in the laboratory the driller's classification is reviewed by a soils engineer who examines each sample.

C. Thin-walled Tube Sampling of Soils (ASTM* Designation: D 1587)

This method consists of forcing a 2" or 3" outside diameter thin wall tube by hydraulic or other means into soils, usually cohesive types. Relatively undisturbed samples are recovered.

D. Soil Investigation and Sampling by Auger Borings (ASTM* Designation: D 1452)

This method consists of augering a hole and removing representative soil samples from the auger flight or bucket at 5'0" intervals or with each change in the substrata. Relatively disturbed samples are obtained and its use is therefore limited to situations where it is satisfactory to determine approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation (ASTM* Designation: D 2113)

This method consists of advancing a hole in hard strata by rotating downward a single tube or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings. Normally a 2" O.D. by 1 3/8" I.D. coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and laboratory. Cores are stored in partitioned boxes and the length of recovered material is expressed as a percentage of the actual distance penetrated.

*American Society for Testing and Materials, Philadelphia, Pennsylvania

APPENDIX C

LOG OF TEST BORING - GENERAL NOTES

UNIFIED SOIL CLASSIFICATION SYSTEM INFORMATION

LOGS OF TEST BORING NOS. B1 - B6A

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LOG OF TEST BORING

General Notes

Descriptive Soil Classification

GRAIN SIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	¾" to 3"	¾" to 3"
Fine	4.76 mm to ¾"	#4 to ¾"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

GENERAL TERMINOLOGY

Physical Characteristics
Color, moisture, grain shape, fineness, etc.

Major Constituents
Clay, silt, sand, gravel

Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.

Geologic Origin
Glacial, alluvial, eolian, residual, etc.

RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

RELATIVE PROPORTIONS OF COHESIONLESS SOILS

Proportional Term	Defining Range By Percentage of Weight
Trace	0%- 5%
Little	5%-12%
Some	12%-35%
And	35%-50%

CONSISTENCY

Term	q_u-tons/sq. ft.
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4-12%
Sedimentary Peat	12-50%
Fibrous and Woody Peat	More than 50%

PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" pentrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

Symbols

DRILLING AND SAMPLING

CS—Continuous Sampling
RC—Rock Coring: Size AW, BW, NW, 2" W
RQD—Rock Quality Designator
RB—Rock Bit
FT—Fish Tail
DC—Drove Casing
C—Casing: Size 2½", NW, 4", HW
CW—Clear Water
DM—Drilling Mud
HSA—Hollow Stem Auger
FA—Flight Auger
HA—Hand Auger
CDA—Clean-Out Auger
SS—2" Diameter Split-Barrel Sample
2ST—2" Diameter Thin-Walled Tube Sample
3ST—3" Diameter Thin-Walled Tube Sample
PT—3" Diameter Piston Tube Sample
AS—Auger Sample
WS—Wash Sample
PTS—Peat Sample
PS—Pitcher Sample
NR—No Recovery
S—Sounding
PMT—Borehole Pressuremeter Test
VS—Vane Shear Test
WPT—Water Pressure Test

LABORATORY TESTS

q_c—Penetrometer Reading, tons/sq. ft.
q_u—Unconfined Strength, tons/sq. ft.
W—Moisture Content, %
LL—Liquid Limit, %
PL—Plastic Limit, %
SL—Shrinkage Limit, %
LI—Loss on Ignition, %
D—Dry Unit Weight, lbs./cu. ft.
pH—Measure of Soil Alkalinity or Acidity
FS—Free Swell, %

WATER LEVEL MEASUREMENT

▽—Water Level at time shown
NW—No Water Encountered
WD—While Drilling
BCR—Before Casing Removal
ACR—After Casing Removal
CW—Caved and Wet
CM—Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

UNIFIED SOIL CLASSIFICATION SYSTEM

COARSE-GRAINED SOILS

(More than half of material is larger than No. 200 seive size.)

GRAVELS More than half of coarse fraction larger than No. 4 sieve size

Clean Gravels (Little or no fines)

GW	Well-graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines

Gravels with Fines (Appreciable amount of fines)

GM^{d}_{u}	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures

SANDS More than half of coarse fraction smaller than No. 4 sieve size

Clean Sands (Little or no fines)

SW	Well-graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines

Sands with Fines (Appreciable amount of fines)

SM^{d}_{u}	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures

FINE-GRAINED SOILS

(More than half of material is smaller than No. 200 sieve.)

SILTS AND CLAYS Liquid limit less than 50%

ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silty clays of low plasticity

SILTS AND CLAYS Liquid limit greater than 50%

MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity, organic silts

HIGHLY ORGANIC SOILS

PT	Peat and other highly organic soils

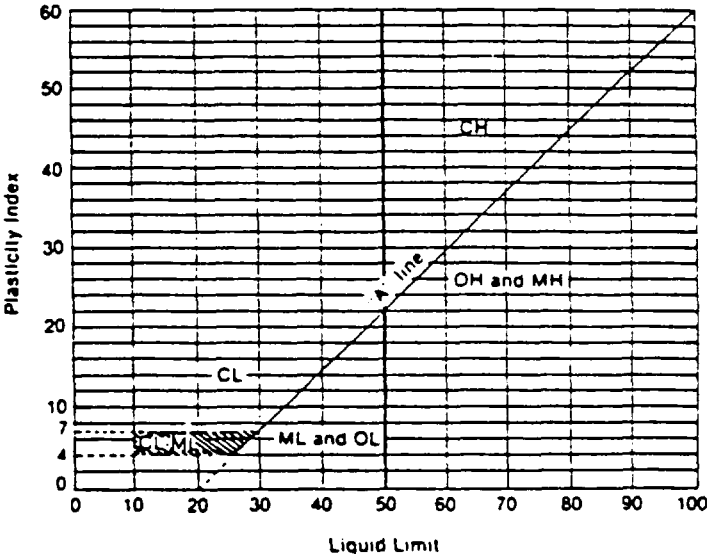
LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 per cent	GW, GP, SW, SP
More than 12 per cent	GM, GC, SM, SC
5 to 12 per cent	Borderline cases requiring dual symbols

PLASTICITY CHART



For classification of fine-grained soils and fine fraction of coarse-grained soils.

Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Equation of A-line: PI = 0.73 (LL - 20)

APPENDIX D

SOIL TEST RESULTS

DRAWING NOS. C 9560-A5 thru C 9560-A8

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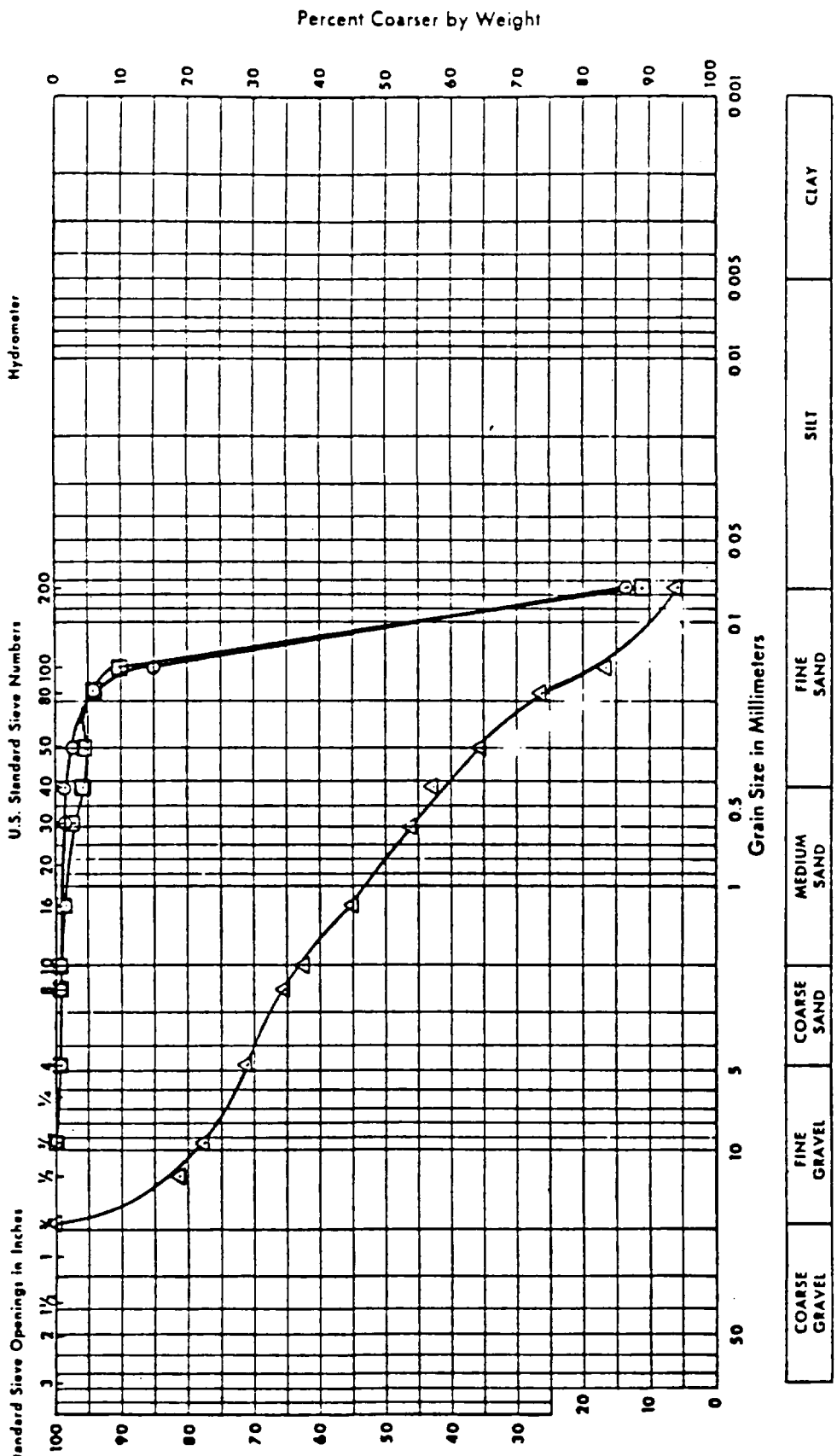

Curve	Sample	Depth	N.M.	L.L.	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
△	B#1, S1A	4.4-6.4	10.2			28.6	65.5	5.9		FINE TO COARSE SAND, LITTLE SILT (SW-SM)
○	B#2, S1A	4.5-6.5	22.5			0.5	85.9	13.6		FINE SAND, SOME SILT (SM)
□	B#2, S1B	7.7-9.7	22.7			0.6	88.4	11.0		FINE SAND, LITTLE SILT (SP-SM)

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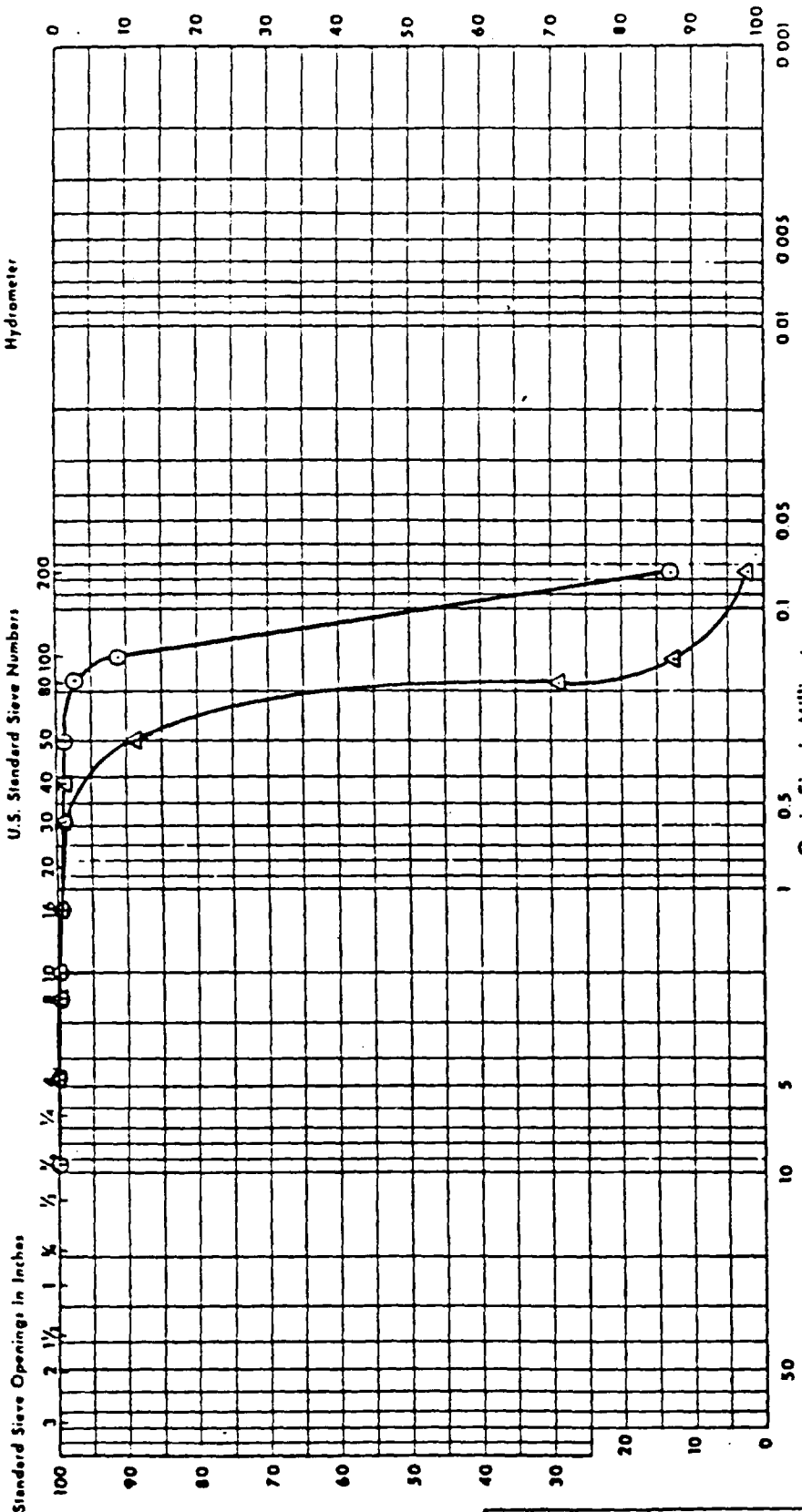
GRAIN SIZE ANALYSIS
SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN, ILLINOIS

DWN LAS	CHK'D GFP	APP'D Daniel R. Vitek	DATE 1/6/81	C9560-A5



Unified Classification System (ASTM D2487)

Curve	Sample	Depth	N.M.	L.L.	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
—○—	B#3, S1A	2.6-4.6	23.8			0.0	97.7	2.3		FINE SAND, TRACE SILT (SP)
—○—	B#3, S2A	4.9-6.9	23.8			0.0	86.6	13.4		FINE SAND, SOME SILT (SM)

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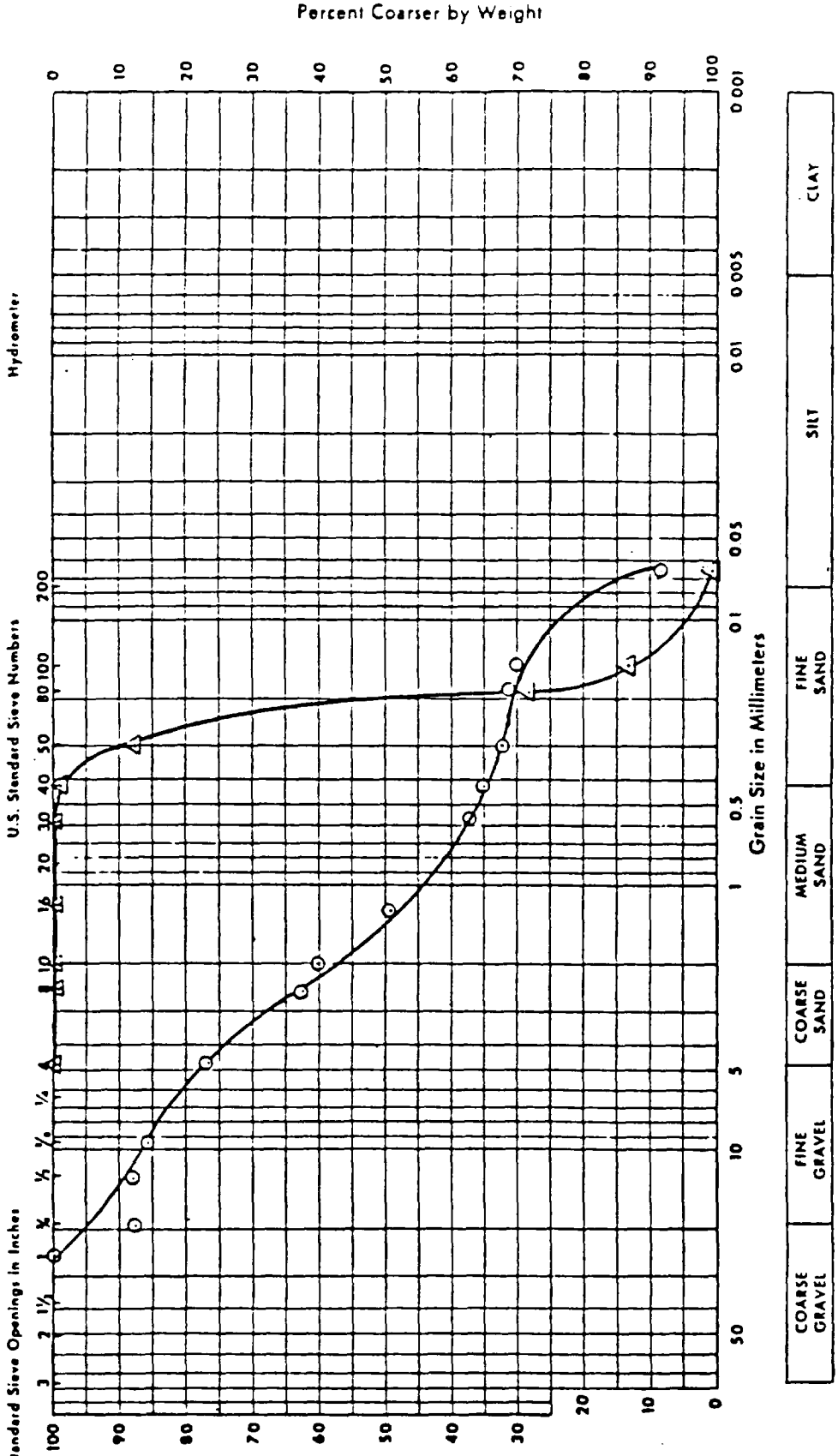
GRAIN SIZE ANALYSIS
SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN, ILLINOIS

DWN KLS	CHK'D GFP	APP'D Daniel R. Urie	DATE 1/6/81	C9560-A

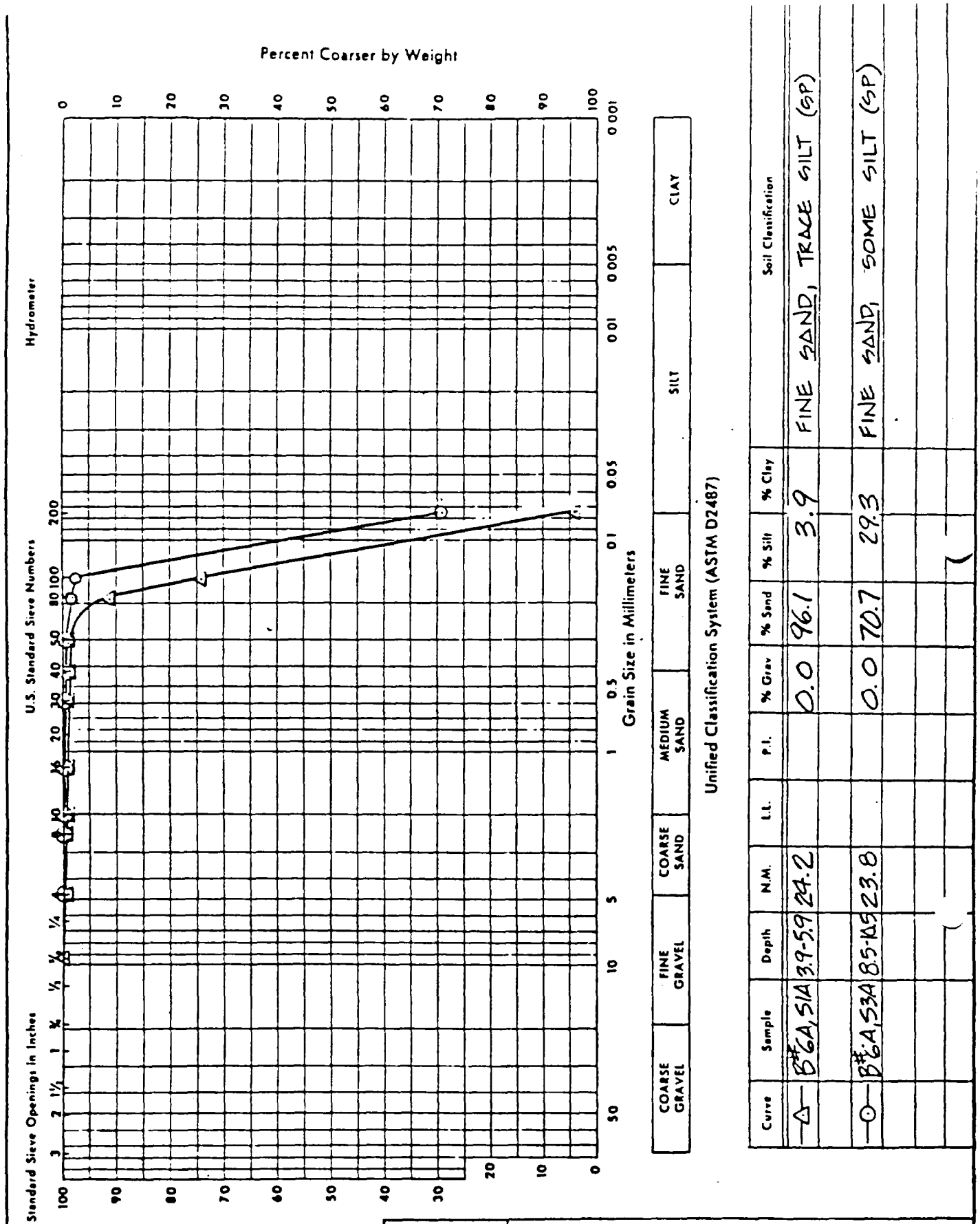


Curve	Sample	Depth	N.M.	L.L.	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
△	B#4, S1A	1.5-3.5	19.9			0.0	99.8	0.2		FINE SAND, TRACE TO NO SILT (SP)
○	B#4, S5A	10.2-11.7	11.3			33.0	59.0	8.0		FINE TO COARSE SAND, SOME GRAVEL, LITTLE SILT (SW-SM)

WARZYN ENGINEERING INC

GRAIN SIZE ANALYSIS
SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN, ILLINOIS

DWN	CHK'D	APP'D	DATE	
RJS	GFP	Daniel R. Vitt	1/6/81	C9560-A7



Curve	Sample	Depth	N.M.	L.L.	P.I.	% Grav	% Sand	% Silt	% Clay	Soil Classification
△	B#6A, S1A	3.9-5.9	24.2			0.0	96.1	3.9		FINE SAND, TRACE SILT (SP)
○	B#6A, S3A	8.5-10.5	23.8			0.0	70.7	29.3		FINE SAND, SOME SILT (SP)

WARZYN ENGINEERING INC

GRAIN SIZE ANALYSIS
SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN, ILLINOIS

DWN RDS	CHK'D GFP	APP'D Daniel R. Vitale	DATE 1/6/81	C9560-A8

APPENDIX E

FIELD PENETRATION TEST RESULTS

DRAWING NOS. C 9560-A1 thru C 9560-A4
and
DRAWING NO. C 9560-B1

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LOG OF TEST BORING

Project: SAND Sample Collection, Waukegan Harbor Slip #3, 45'SE of NW End of Slip & 5'SW of Retaining Wall

Location:

Boring No. B1

Surface Elevation 2.33' below B.M.

Job No. C 9560

Sheet 1 of 1

1409 EMIL STREET • P.O. BOX 9538, MADISON, WIS. 53715 • TEL. (608) 257-4848

SAMPLE No.	Type	Recovery ↓	Moisture ↓	N	Depth	VISUAL CLASSIFICATION and Remarks
					5	WATER to 9.8 feet
					10	Very Loose, Black, Organic Clayey SILT, Trace Fine Sand (Muck) (OL)
1	SS	15	W	14	15	Medium Dense, Gray Fine to Coarse SAND, Some Fine Gravel, Little Silt, Very Oily (SW-SM)
2	SS	17	M	33		*
					20	End Boring at 18.0'
					25	* Very Stiff, Gray, Silty CLAY, Little Fine to Coarse Sand, Little Fine to Coarse Gravel. Very Oily
					30	
					35	
					40	

SOIL PROPERTIES

Qu	W	LL	PL	D

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 11/22/80 Complete 11/22/80

Crew Chief SL Rig 55-2

Drilling Method CS 14.2' to 18.0'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: SAND Sample Collection
Waukegan Harbor Slip #3
83'SE of NW End of Slip & 44'SW of Retaining Wall
Location:

Boring No. B2
Surface Elevation 2.14' below B.M.
Job No. C 9560
Sheet 1 of 1

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SAMPLE No.	Type	Recovery ↓	Moisture ↓	N	Depth	VISUAL CLASSIFICATION and Remarks
						WATER to 7.5 feet
					10	Very Loose, Black, Organic Clayey SILT, Some Fine Sand (Muck) (OL)
1	SS	15	W	15		Medium Dense, Gray Fine SAND, Some Silt (SM)
2	SS	10	W	13	15	*
3	SS	16	M	28		**
					20	End Boring at 19.3'
					25	* Medium Dense, Dark Gray to Black Fine to Coarse SAND, Some Fine Gravel, Little Silt (SW-SM)
					30	** Very Stiff, Gray Silty CLAY, Little Fine to Coarse Sand, Trace Fine to Coarse Gravel
					35	
					40	

SOIL PROPERTIES

Qu	W	LL	PL	D

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 11/21/80 Complete 11/21/80
Crew Chief WG Rig 55-2
Drilling Method CS 11.75' to 19.3'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: SAND Sample Collection
Waukegan Harbor Slip #3
125'SE of NW End of Slip & 45'SW
Location: of Retaining Wall

Boring No. B3
Surface Elevation 2.22' below B.M.
Job No. C 9560
Sheet 1 of 1

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SAMPLE No.	Type	Recovery ↓	Moisture ↓	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						WATER to 9.2'					
					10	Very Loose, Black, Organic Clayey SILT Trace Fine Sand (Muck) (OL)					
1	SS	11	W	10							
2	SS	13	W	27	15	Medium Dense, Gray Fine SAND, Trace Silt (SP)					
3	SS	15	W	32							
					20	End Boring at 18.5'					
						* Very Stiff, Gray, CLAY, Some Silt, Little Fine to Medium Sand, Trace Fine to Medium Gravel					
					25						
					30						
					35						
					40						

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 11/21/80 Complete 11/21/80
Crew Chief WG Rig 55-2
Drilling Method CS 12.0' to 18.5'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: SAND Sample Collection Waukegan Habor Slip #3

Location: 166'SE of NW End of Slip & 11'NW of Retaining Wall

Boring No. B4

Surface Elevation 2.55' below B.M.

Job No. C 9560

Sheet 1 of 1

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SAMPLE No.	Type	Recovery ↓	Moisture ↓	N	Depth	VISUAL CLASSIFICATION and Remarks
						WATER to 6.5'
					5	
						Very Loose, Black, Organic Clayey SILT Trace Fine Sand (Muck) (OL)
					10	
1	3"ST	15	W	-		Pushed Tube 10.5'-12.5', 15" Recovery of Medium Dense, Gray Fine SAND, Trace Silt (SP)
2	3"ST	16	W	-		Pushed Tube 12.5'-14.5', 16" Recovery, Same As Sample 1
3	SS	12	W	28	15	3" Lense of Coarse Sand & Fine Gravel @ 14.7', Pushed Tube 16.5'-18.0' (Refusal) 14" Recovery *
4	3"ST	14	W	-		
5	SS	11	W	72		
6	SS	14	M	60	20	**
						End Boring at 20.5'
					25	
						* Gravel Lense at 18.5'
					30	
						** Very Stiff, Gray, CLAY, Some Silt, Little Fine to Coarse Sand, Trace Fine to Medium Gravel
					35	
					40	

SOIL PROPERTIES				
Q_u	W	LL	PL	D
	-			

WATER LEVEL OBSERVATIONS

While Drilling

Upon Completion of Drilling

Time After Drilling

Depth to Water

Depth to Cave In

GENERAL NOTES

Start 11/20/80 Complete 11/20/80

Crew Chief WG Rig 55-2

Drilling Method CS 10.5' to 20.5'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: SAND Sample Collection
Waukegan Harbor Slip #3
200'SE of NW End of Slip &
Location: 47'SW of Retaining Wall

Boring No. B5
Surface Elevation 2.42' below B.M.
Job No. C 9560
Sheet 1 of 1

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SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
Recovery			Moisture								
No.	Type	↓	↓	N	Depth		Qu	W	LL	PL	D
						WATER to 9.2'					
					5						
						*					
					10	**					
1	3"ST	18	W	-							
						End Boring at 11.7'					
					15						
						* Very Loose, Black Organic SILT, Some Fine Sand (OL)					
					20	** Pushed Tube 9.7' to 11.7', 18" Recovery of Medium Dense, Gray Fine SAND, Trace Silt, (SP)					
						*** Gray Silty CLAY (Assumed)					
					25						
					30						
					35						
					40						

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 11/19/80 Complete 11/19/80
Crew Chief WG Rig 55-2
Drilling Method CS 9.7' to 11.7'

WARZYN ENGINEERING INC

LOG OF TEST BORING

Project: SAND Sample Collection Waukegan Harbor Slip #3
Location: 35'SE of NW End of Slip & 39'SW of Retaining Wall

Boring No. B6A
Surface Elevation 2.25' below B.M.
Job No. C 9560
Sheet 1 of 1

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SAMPLE No.	Type	Recovery ↓	Moisture ↓	N	Depth	VISUAL CLASSIFICATION and Remarks
						WATER to 6.5'
					5	
						Very Loose, Black Organic Clayey SILT Some Fine Sand (Muck) (OL)
					10	
1	SS	13	W	16		*
2	SS	13	W	22		Medium Dense, Gray Fine SAND, Trace Silt (SP)
					15	
3	SS	15	W	39		Dense Gray, Fine SAND, Some Silt (SM)
4	SS	16	W	31		**
					20	End Boring at 19.0'
						* Medium Dense, Black Fine SAND, Trace Silt (SP)
					25	** Very Stiff, Gray Silty CLAY, Little Fine to Coarse Sand, Little Fine to Coarse Gravel
					30	
					35	
					40	

SOIL PROPERTIES				
q_u	W	LL	PL	D

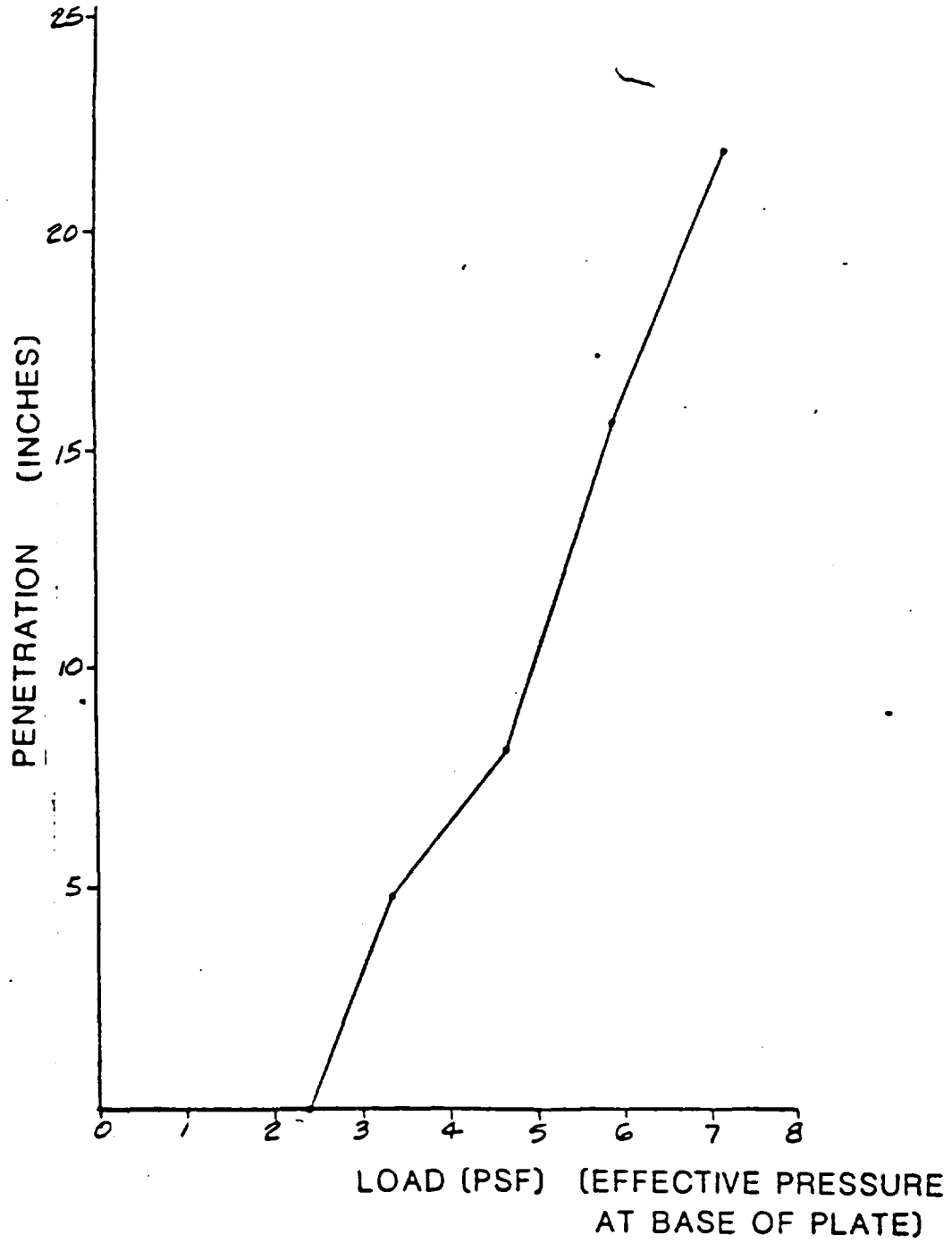
WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave In

GENERAL NOTES

Start 11/21/80 Complete 11/21/80
Crew Chief SL Rig 55-2
Drilling Method CS 10.6' to 19.0'

TEST #1 Located at End of Pier 2



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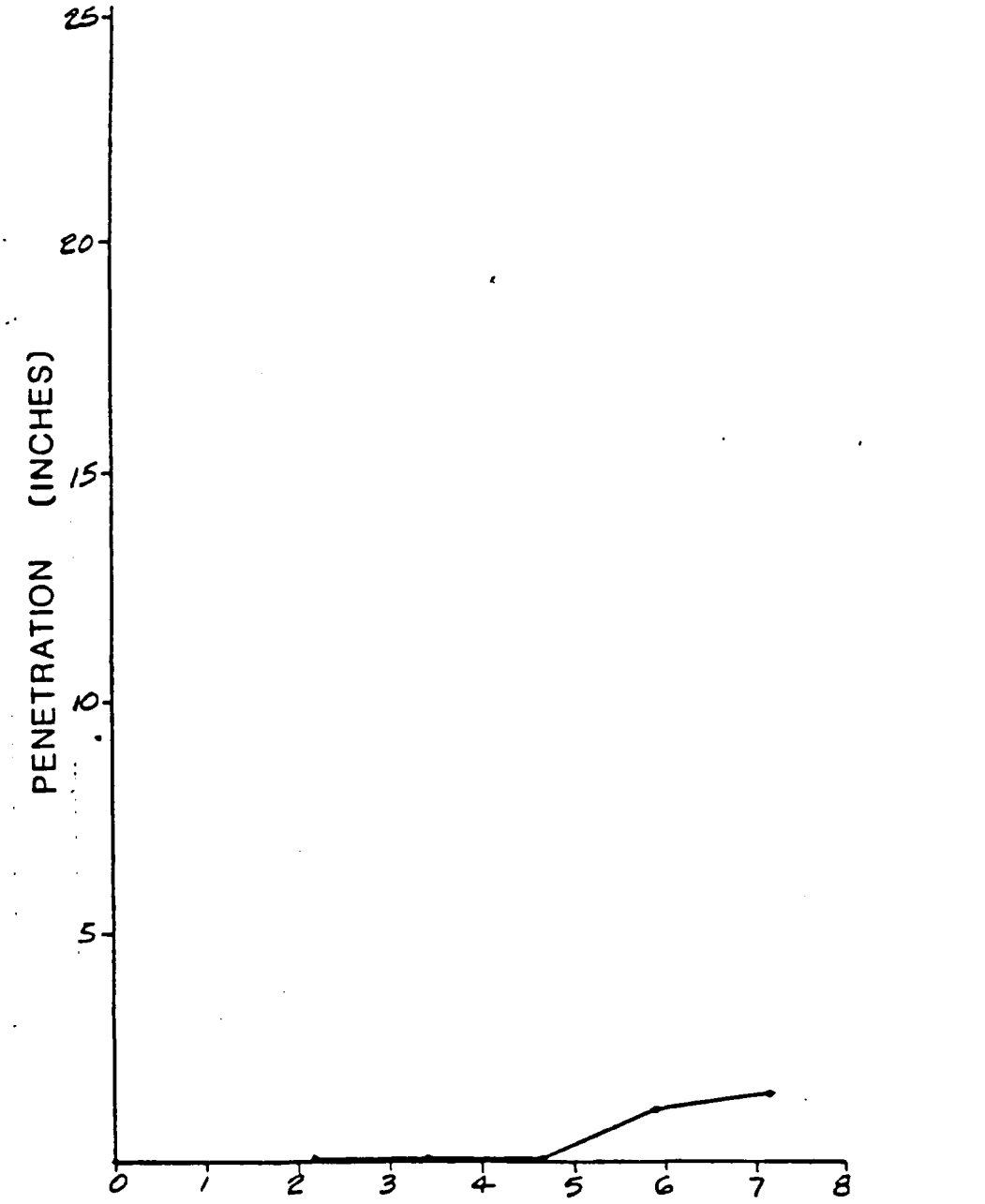
FIELD PENETRATION TEST

SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN ILLINOIS

DWN	CHK'D	APP'D	DATE	
	GFP	Daniel R. Vita	1/6/81	C9560-A1

TEST #2 Located at End of Pier 3



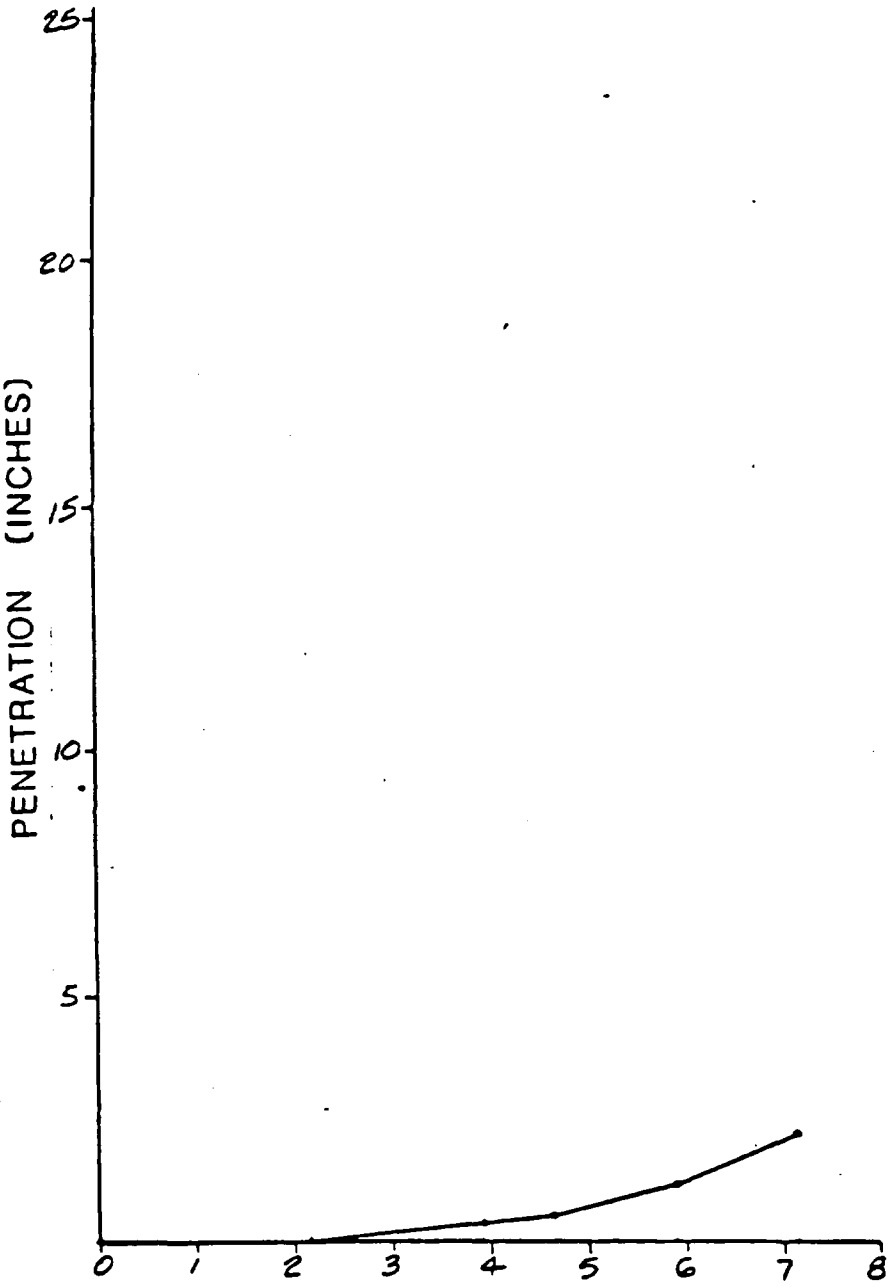
WARZYN ENGINEERING INC

FIELD PENETRATION TEST

SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN ILLINOIS

DWN DLS	CHK DGFP	APP'D Daniel R. Visti	DATE 1/6/81	C9560-A2

TEST #3 Located at End of Pier 4

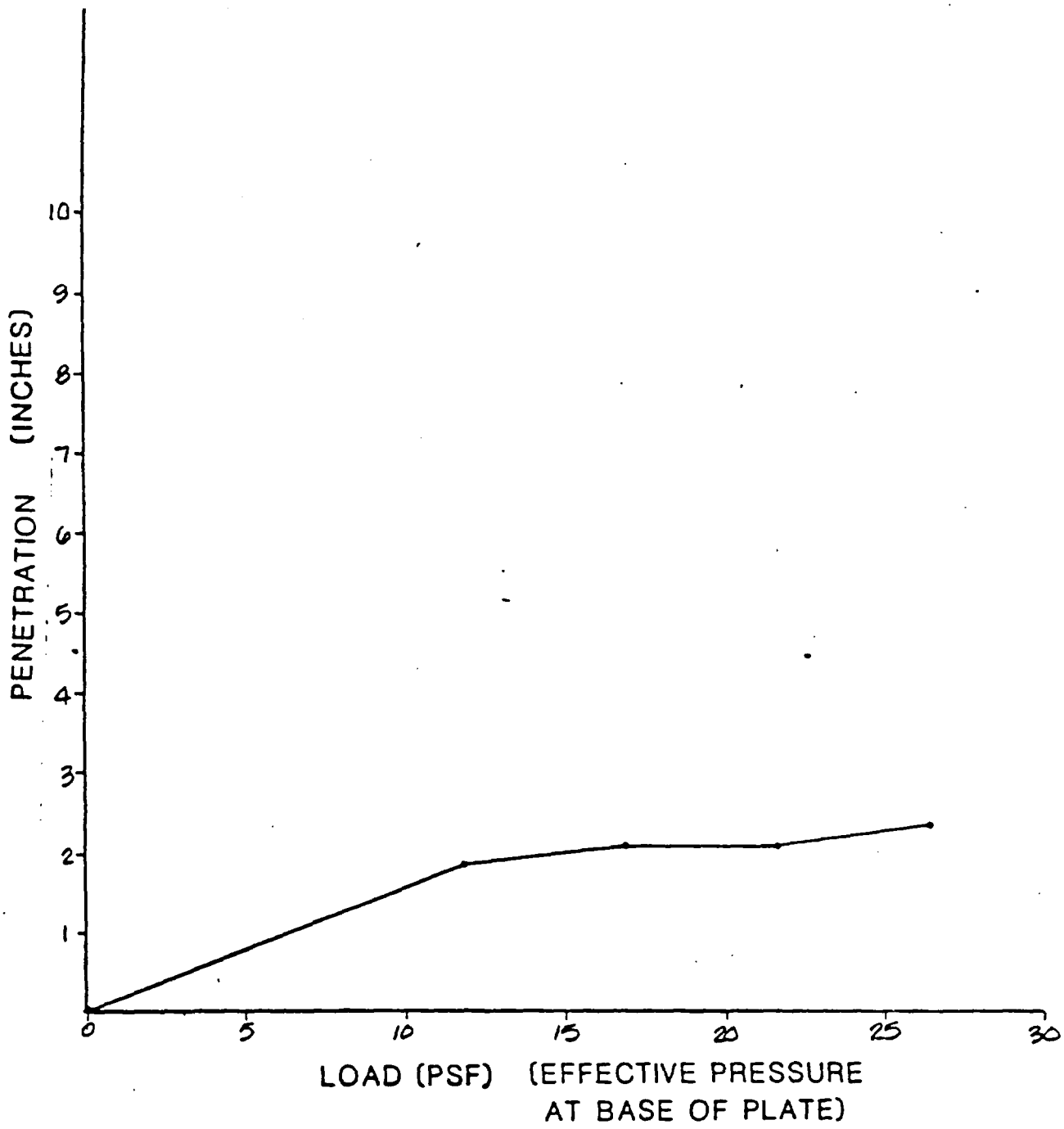


WARZYN ENGINEERING INC

FIELD PENETRATION TEST
SAND SAMPLE COLLECTION
WAUKEGAN HARBOR SLIP #3
WAUKEGAN ILLINOIS

DWN LCS	CHK'D GFP	APP'D Daniel R. Vitale	DATE 1/6/81	C4560-A3

TEST #4 Located at End of Pier 5



WARZYN ENGINEERING INC	FIELD PENETRATION TEST SAND SAMPLE COLLECTION WAUKEGAN HARBOR SLIP #3 WAUKEGAN ILLINOIS			
DWN LLS	CHK'D GFP	APP'D Daniel R. Vitt	DATE 6/6/81	C9560-A4